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COMPARISON OF SPINNING PERFORMANCES OF COTTONS WITH VARYING FIBER PROPERTIES, SAN JOAQUIN VALLEY OF CALIFORNIA, 1964-65 SEASON

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COMPARISON OF SPINNING PERFORMANCES OF COTTONS WITH VARYING FIBER PROPERTIES, SAN JOAQUIN VALLEY OF CALIFORNIA, 1964–65 SEASON

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INTRODUCTION

Textile mills have increased their quality requirements for cotton fiber as a result of new processing techniques. The breeder, in his endeavor to keep up with the rapidly changing mill requirements, has improved the quality of Acala 4–42 cotton so that it continues to meet these requirements. This cotton is grown in the San Joaquin Valley, Calif. Through inherent fiber quality improvements in the variety and modified production practices, the San Joaquin Valley-grown Acala 4–42 has gained an exceptionally fine market acceptance. While these endeavors were being pursued with 4–42, the breeder also was able to develop several new Acala strains that appear promising.

The breeder was striving for specific agronomic improvements in the new strains and at the same time to retain the level of 4–42 fiber properties as minimum standards. These improvements were an increased fruit retention during the midbloom period, erect main stems for efficient harvest, and a more uniform maturing of fruit to permit earlier machine picking. Each of these features could contribute significantly to production efficiency. New strains were developed that appeared to have these features. However, in the miniature spinning tests, certain new strains had a lower quality yarn than Acala 4–42, even though fiber property data had shown little or no difference.

The purpose of this study was to determine the relative spinning performance of four new Acala strains and the relationship of their fiber properties to spinning performance and yarn quality. In this way, further genetic improvements may be possible in both production efficiency and fiber quality.

METHOD OF STUDY

Strain Entries and Field Test Locations

Four new Acala strains and Acala 4–42 were chosen for this study. The five entries were constituted as follows:

Strain designation	*Component lines*
1. 1–63	100 percent AxTE 1–63.
2. 67–2	33⅓ percent each AxTE 1–63, 12302, 842.
3. 67–4	33⅓ percent each AxTE 1–63, 1842, 842.
4. Expt. Acala	33⅓ percent each AxTE 1–63, 122, 842.
5. Acala 4–42 check	100 percent 4–42–77.

The 1–63 strain possessed the plant features that expressed the agronomic improvements that the breeder was endeavoring to capture more fully in the new Acalas. Except for a lower length uniformity, fiber data of previous years had indicated that the fiber properties of 1–63 were similar to those of Acala 4–42. Results of the miniature spinning tests, however, had indicated that the yarn strength of 1–63 might be 4 to 8 percent lower than that of 4–42. Consequently, the other entries in this study (representing seed composites of 1–63 with related lines) were chosen to determine whether the yarn strength deficiency of 1–63 could be overcome by use of composites.

The four locations chosen for this test embrace the range of environmental growing conditions in the San Joaquin Valley. They were as follows:

Location No.	Test location	Valley area
1	Raisin City	North central.
2	Shafter	Southern.
3	Tri-City	South central.
4	Chowchilla	Northern.

Harvesting and Ginning

Harvesting and ginning procedures on the test cottons were followed that would do the least amount of damage to the fiber. The cotton was machine harvested at all the sites using the cooperating growers' picking machines. The picking was done carefully to preserve the quality of the cotton. Only the first pickings were used in the quality study. Ginning was carefully controlled to avoid excessive drying and cleaning. At each of the four test sites, two bales of cotton were saved for each of the five strains studied. Thus, 40 bales of cotton were utilized in the fiber and spinning tests, representing five strains, four locations, and two replications per location.

Processing and Testing

The processing was done by Textile Research Laboratory of Texas Technological College in Lubbock, Tex., under a research contract with Market Quality Research Division of Agricultural Research Service.

Each bale was processed individually into a 14-ounce-per-yard picker lap and carded at 10 pounds per hour using card crusher rolls. After processing through breaker and finisher drawing, the sliver was processed into 1.25 hank roving using a 1.15-twist multiplier. At spinning, a full doff of 40s yarn was spun using a 3.68-twist multiplier at a spindle speed of 13,000 revolutions per minute. Most lots were run for 5,760 spindle-hours, but some lots, because of insufficient cotton, were run for only 3,840 spindle-hours.

For fiber testing, samples were taken when each bale was opened. These samples were tested under standard atmospheric conditions (70° F. and 65 percent relative humidity) for length and length uniformity, fineness, strength, and nonlint content. The amount of waste removed at each process was weighed. At carding, nep counts were made. At spinning, ends-down were recorded at 15-minute intervals, and yarn tests were made for size, skein strength, appearance, and imperfections.

Statistical Analysis

Data were analyzed for statistical significance by analysis of variance. Each analysis consisted of four locations with five strains for each location and two replications per strain. When significant interactions between strains and locations occurred, a separate analysis of variance was made for each location. Differences required (at 95-percent level) for significance between all pairs of treatment means were based on a Duncan's Multiple Range test.[1]

TEST RESULTS

In appendix tables 1 and 2, mean values for measurements of fiber and spinning qualities are given separately by strains and by locations, along with the level of significance and difference required.

Strains (table 1)

Although differences in upper quartile length were small among all strains tested, the 67–4 and Experimental Acala strains were significantly shorter than the others. In contrast, differences in Fibrograph measurements for the 2.5-percent span length were insignificant.

The major differences in fiber length characteristics among the strains were in measurements of mean length and length uniformity. For example, the mean lengths for the 67–2 and Acala 4–42 strains were significantly longer than that for the other strains. On the other hand, length uniformity, as measured by the coefficient of variation, was significantly lower for the 1–63 strain compared with the others. This lack of length uniformity was also evident from the significantly higher percentage of short fibers shown for 1–63. The 67–2 and Acala 4–42 strains gave the most uniform fiber length, and differences between these strains were not significant. This relationship between strains for length uniformity was also shown by the 50/2.5 ratio.

Fiber fineness, as determined by the Micronaire, differed significantly among the strains. The 1–63 strain had significantly lower readings than any of the other strains, which possibly indicated a slight fiber immaturity. Micronaire value of Acala 4–42 was significantly lower than that of 67–2, 67–4, and Experimental Acala, but even the highest micronaire values recorded were not of the magnitude to classify as coarse fiber.

Fiber strength of Acala 4–42, as measured at the 0 gage of the Pressley tester was significantly lower than that for all the other strains; however, when measured on the Stelometer at the ⅛-inch gage, differences among strains were insignificant. In general, the ⅛-inch gage values have been found to be more closely correlated with yarn strength than the 0 gage values.

The nonlint content and manufacturing waste for the 1–63 strain were significantly higher than for the other strains. This is probably the result of two inherent features of the 1–63 strain; namely, (1) its finer fiber that is more likely to cling to leaves and other plant trash when subjected to the same harvesting and ginning methods as the higher micronaire strains, and (2) its early crop maturity that allows a higher proportion of the total fruit to be harvested in the first picking (only first pickings were used in this quality study).

No significant differences among strains existed for neps in card web or for yarn appearance. The Acala 4–42 strain, however, produced a yarn which was more uniform than the other strains, as shown by the measurements for yarn irregularity.

The break factors for yarn of the Acala 4–42 and the 67–2 strains were not significantly different. Acala 4–42 produced yarn which was stronger than that of 1–63, 67–4, and Experimental Acala strains. The composite strains, 67–4 and Experimental Acala, were not a significant improvement over 1–63. Evidently, the superior fiber characteristics of length uniformity, mean length, and low content of short fibers for 67–2 and 4–42 were largely the features influencing yarn strength.

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[1] Duncan, David B. MULTIPLE RANGE AND MULTIPLE F TESTS. Biometrics 11: 1–42. 1955.

The differences in spinning performance, as determined by ends-down per 1,000 spindle-hours (EDMSH), among the strains were large but not statistically significant at 95-percent confidence level. The level of EDMSH varied considerably between replications and locations, making it difficult to detect any differences that might exist for this spinning feature.

Locations (table 2)

Cotton from each location was processed at separate gins. Therefore, it was impossible to separate the effects of field management and environment from those of ginning on fiber properties. Hence, any significant difference shown in this section could have been caused by location of plots, gins, or an interaction between location and gin.

Except for the 2.5-percent span length, all length measurements for cotton produced at Chowchilla were significantly superior to those for cotton produced at Shafter. This could have been due to the very late planting and delay in harvesting of the Shafter plots. When the Shafter plots were harvested, all the fruit was open, but only 80 to 85 percent of the fruit was open when the other sites were harvested. Cotton from Chowchilla also tended to be longer and more uniform in length than the cotton from Tri-City or Raisin City.

The micronaire reading was significantly higher for cotton at Raisin City than at the other three locations. The Raisin City plots had excellent agronomic management, and were free of Verticillium wilt damage. Both these factors undoubtedly contributed to the development of more mature fibers and are reflected in the higher micronaire values. A weaker fiber was produced at Raisin City as measured by the 0 gage strength test, but according to the ⅛-inch gage measure of fiber strength, no significant differences occurred among locations.

The nonlint content, according to the Shirley Analyzer, and manufacturing waste were significantly lower in the cotton grown at Tri-City than at Chowchilla. This difference may be attributed to the skippy stand and excessive weeds in the Chowchilla test plot at harvest and not to its specific location in the valley.

Among the locations studied, no significant differences occurred in the cottons for neps, yarn appearance, and yarn irregularity. Break factors, however, differed significantly among locations. The superior length characteristics for cotton from Chowchilla, for example, may have contributed to the higher yarn break factors for this location. Skippy and weedy plots in the San Joaquin Valley, such as the Chowchilla plot, often produce a longer and stronger fiber.

Spinning end breakage (EDMSH) for cottons from Tri-City, Raisin City, and Chowchilla did not differ significantly. Cotton from the Shafter plots produced the highest level of EDMSH. This was probably due to the late harvest of the Shafter plots which include all the top fruit that is generally considered the weakest fiber on the plants.

Interactions of Strains and Locations

Significant interactions between strains and locations existed for array measurements of length and for yarn irregularity. Therefore, subanalyses were made for those properties at each location.

At Shafter, none of the array measurements for strains differed significantly. At the other locations, however, most array measurements differed significantly. Generally, these subanalyses showed that the length uniformity of Acala 4–42 was as good as it was for the other strains, or better. Strains 67–2 and Acala 4–42 tended to have longer upper quartile length, longer mean length, and lower short-fiber content than the other strains. The erratic array measurements for 67–4 and Experimental Acala from location to location probably accounted for the significant interactions. It was not possible from this study to determine the cause of this differential location response.

For yarn irregularity, none of the strains at Chowchilla differed significantly. At the other locations, significant differences existed. The main difference in yarn irregularity was between Acala 4–42 and 1–63. It was lower in Acala 4–42 than in 1–63 at every location, although differences between these two strains were not statistically significant at Shafter and Chowchilla. The differential response of 67–4 and Experimental Acala from the Shafter location no doubt accounted for the significant location–strains interactions.

With the number of possible variables involved in locations, emphasis upon any specific interaction between strains and locations in this study is probably unwarranted.

SUMMARY AND CONCLUSIONS

In the study, five strains of Acala cotton were tested to determine the spinning performance and fiber properties of each. The strains tested were 1–63, 67–2, 67–4, and Experimental Acala (four new strains), and Acala 4–42 (the commercially grown variety). The cotton was grown at four test locations in the San Joaquin Valley of California during the 1964–65 season.

The new strains represent potential agronomic improvements in Acala cotton that could contribute significantly to production efficiency. However, preliminary spinning tests showed that these new strains had a weaker yarn than Acala 4–42, even though fiber property data had shown little or no difference. Since the textile mills are well satisfied with the fiber quality and spinning performance of Acala 4–42, the new strains were analyzed, along with Acala 4–42, to determine the relationship of their fiber properties to spinning performance and yarn quality. In this way, the deficiencies in strains could be pinpointed and agronomists would be able to make the specific improvements indicated by the data.

Important findings of the study were:

- The 1–63 strain, among the five strains spun, gave the lowest quality yarn and Acala 4–42 and 67–2, the highest quality.
- Acala 4–42 and 67–2 had superior fiber characteristics of mean length, length uniformity, and low content of short fibers, which probably accounted for their superior spinning performance.
- The 1–63 fiber measurements of upper quartile length, 2.5-percent span length, 0 gage and 1/8-inch gage strength were equal to Acala 4–42 and 67–2, the two superior strains. This indicated that these fiber properties were not factors influencing the lower spinning performance and lower yarn quality of 1–63.
- The 67–4 and Experimental Acala strains were intermediate in practically all measurements. This indicated that the quality of the other component lines involved in these two strains was not sufficient to overcome the inferior performance of 1–63, which was used as a common component line in all four of the new Acala strains.
- Locations of plots had some bearing on fiber measurements and spinning performance. Cotton produced at Chowchilla was superior to that produced at Shafter. Planting and harvesting dates, cultural management, and ginning were each involved in the effect of location on fiber properties. Any differences in quality for test sites, therefore, cannot be related solely to *location*, but could be attributed to either of these three variables embraced under location or the interactions between these variables.

APPENDIX

TABLE 1.—*Mean values for fiber properties and spinning performance of 5 strains of Acala cotton produced at 4 test locations, San Joaquin Valley, Calif., 1964–65 season*

Measurement [1]	1–63	67–2	67–4	Expt. Acala	Acala 4–42	Significance [2]	
						Diff. req.	Level
ARRAY							
UQL (inches)	1. 23	1. 24	1. 22	1. 22	1. 23	0. 010	99
Mean (inches)	. 98	1. 02	0. 99	1. 00	1. 02	. 015	99
Coefficient of variation (percent)	34	31	32	31	30	1. 09	99
Fibers ½-inch and shorter (percent)	12. 3	9. 8	10. 6	10. 3	9. 2	. 92	99
FIBROGRAPH							
2.5 percent SL (inches)	1. 110	1. 115	1. 105	1. 110	1. 110	. 014	N.S.
50/2.5 ratio (UI) (percent)	44. 5	45. 5	45. 5	45. 0	46. 0	. 86	95
MICRONAIRE							
Reading	3. 80	4. 20	4. 23	4. 19	4. 11	. 08	99
PRESSLEY							
0 gage (1,000 psi)	94. 8	96. 7	95. 6	96. 4	93. 3	1. 5	99
STELOMETER							
⅛-inch gage (grams/grex)	2. 60	2. 56	2. 59	2. 56	2. 58	. 06	N.S.
SHIRLEY ANALYZER							
Nonlint content (percent)	2. 81	2. 20	2. 23	2. 37	2. 21	. 25	99
PROCESSING (For 40s yarn)							
Manufacturing waste (percent)	6. 77	5. 98	6. 12	6. 11	5. 79	. 59	95
Neps/100 square inches in card web	8. 1	8. 2	8. 7	8. 4	8. 2	. 63	N.S.
Yarn appearance (index)	74. 4	74. 7	77. 4	78. 1	79. 7	5. 8	N.S.
Yarn irregularity CV (percent)	22. 91	22. 18	22. 27	22. 31	21. 37	. 41	95
Break factor (units)	2308	2389	2365	2334	2439	57. 1	99
EDMSH (number)	55. 8	49. 1	51. 6	47. 7	31. 9	19. 4	85

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[1] UQL=upper quartile length; SL=span length; UI=uniformity index; EDMSH=ends-down per 1,000 spindle-hours.

[2] Difference required for significance is based on Duncan's Multiple Range test. The figures given for level of significance are based on the analysis of variance (N.S.=not significant).

TABLE 2.—*Mean values for fiber properties and spinning performance of Acala cotton, by location of test plots, San Joaquin Valley, Calif., 1964–65 season*

Measurement [1]	Raisin City	Shafter	Tri-City	Chowchilla	Significance [2]	
					Diff. req.	Level
ARRAY						
UQL (inches)	1. 22	1. 22	1. 23	1. 24	0. 015	90
Mean (inches)	1. 01	0. 96	1. 00	1. 03	. 018	99
Coefficient of variation (percent)	30	35	31	30	1. 3	99
Fibers ½-inch and shorter (percent)	9. 1	13. 4	10. 2	9. 1	. 9	99
FIBROGRAPH						
2.5 percent SL (inches)	1. 108	1. 108	1. 112	1. 112	. 011	N.S.
50/2.5 ratio (UI) (percent)	45. 2	43. 8	45. 2	47. 0	1. 18	99
MICRONAIRE						
Reading	4. 38	4. 00	3. 99	4. 06	. 27	95
PRESSLEY						
0 gage (1,000 psi)	92. 8	95. 8	97. 3	95. 5	2. 6	95
STELOMETER						
⅛-inch gage (grams/grex)	2. 52	2. 57	2. 56	2. 65	. 12	N.S.
SHIRLEY ANALYZER						
Nonlint content (percent)	2. 53	2. 40	1. 84	2. 69	. 70	90
PROCESSING (For 40s yarn)						
Manufacturing waste (percent)	6. 06	6. 23	5. 42	6. 90	. 92	95
Neps/100 square inches in card web	8. 2	8. 7	7. 8	8. 6	7. 1	N.S.
Yarn appearance (index)	77. 1	77. 6	74. 3	78. 5	4. 0	N.S.
Yarn irregularity CV (percent)	21. 93	23. 10	21. 93	21. 87	1. 40	N.S.
Break factor (units)	2299	2263	2397	2509	143	95
EDMSH (number)	49. 7	71. 8	29. 6	38. 0	40	85

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[1] UQL=upper quartile length; SL=span length; UI=uniformity index; EDMSH=ends-down per 1,000 spindle-hours.

[2] Difference required for significance is based on Duncan's Multiple Range test. The figures given for level of significance are based on the analysis of variance (N.S.=not significant).

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